

LEAN CONSTRUCTION AS AN EMERGENT OPERATIONS STRATEGY

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ABSTRACT

All companies have an operations strategy; a pattern of decisions made in operations with the purpose to support the business strategy. Lean Construction can be seen as an operations strategy. Under the assumption that an operations strategy is emergent, it should be traceable on the tactical level of a company. The aim of this research is to detect the emergent operations strategy at construction companies and contrast it with existing research on decision categories. An interview study with nine middle managers at different Swedish contractors was organised. All respondents are active on the tactical level of their respective companies. The in-depth interviews were transcribed and the transcriptions analysed to identify categories that are focused in daily operational decisions. According to operations management literature, it is in the daily decision making that the operations strategy is created and enacted. The differences between companies with and without a Lean implementation were analysed. Some of the managers claiming to work according to Lean principles displayed many similarities with managers which are not. Furthermore, managers (and their companies) without a clear statement on Lean implementation still embrace many of the basic Lean principles. The emerging categories were compared to existing publications of decision categories. The result shows that Lean principles can constitute part of a construction company's operations strategy without them having an acclaimed Lean implementation. Treating the operations strategy as emergent from daily actions is a successful way of detecting it.

KEYWORDS

Operations, process, production, production system design, strategy.

INTRODUCTION

Every firm has a business strategy and an operations strategy, Fig. 1. The business strategy frames *what* products and on what market (*where*) these will be offered. An operations strategy is a long-range plan for the operations function, (Anderson et al. 1989). The operations strategy (Skinner 1969) frames *how* operations should be

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conducted on the tactical firm level, and is often emergent; traceable as a pattern of decisions (Slack and Lewis 2011). Emergent should be interpreted as opposed to applied – an emergent operations strategy is the strategy that is actually enacted as it emerges as a pattern of decisions made in the organisation. Lean Construction (Koskela 1992) can be perceived as an operations strategy (Slack and Lewis 2011). As such, it should be traceable on the tactical level of a firm as a pattern of decisions. If Lean Construction is not implemented, the operations strategy should have a different pattern of decisions. Tracing the emergent operations strategy could therefore be a way to discover the quality and depth of Lean implementation.

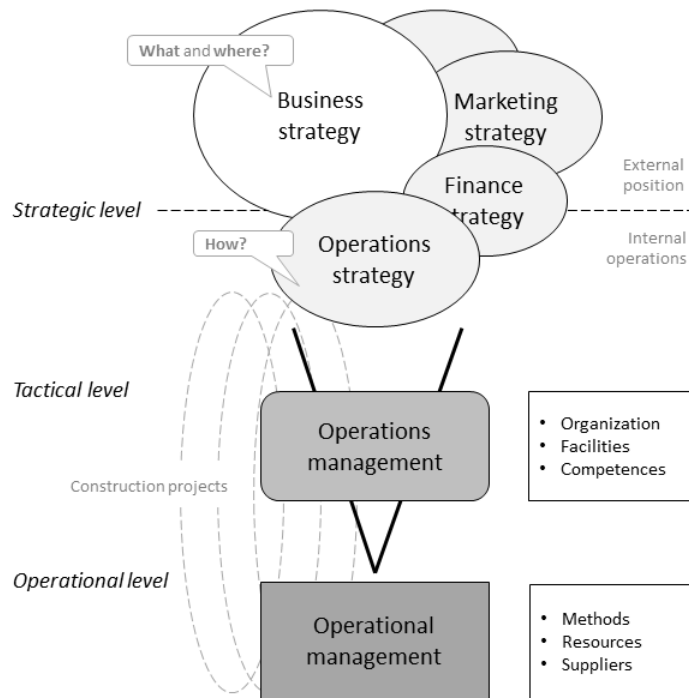


Figure 1: Levels of operations and strategies in a single-business firm.

The aim of this research is to trace the operations strategy at different contractor firms, identify the decisions made and their interpretation as emergent themes from interview data. In Lidelöw and Simu (2015), existing theories were forced upon empirical data, whereas in this research the pattern of decisions emerges from the data. Information was obtained from semi-structured interviews with a tactical level representative of each firm, including open questions about their respective firms' operations, conduct, and management. The work is concluded by reconnecting with the theoretical decision categories presented in Rudberg and Olhager (2003).

STRATEGIC ASPECTS OF LEAN CONSTRUCTION

Upon realizing that construction is another type of production (Childerhouse et al. 2000) than mass production, it also became clear that the relationship between operations and the firm itself differs from that in manufacturing firms. Organizing production in

construction projects called for a redefinition of Lean principles into Lean Construction (Koskela 1992). Producing in projects offers the possibility (and the risk) to revalue the supply chain in every project to fit customer demands (Childerhouse et al. 2000).

The basic incentive for implementing Lean in the manufacturing industry is to turn manufacturing into a competitive advantage by shortening lead times and increasing quality (Almeida and Salazar 2003). Lean Construction is likewise implemented to improve the execution of construction projects by applying methods as JIT, concurrent engineering, and Last Planner (Ballard 1994). The organization supporting the projects and the business strategy need to be aligned with the Lean Construction operations strategy ((Porter 1996; Filho et al. 2011). Ballard et al. (2001) propose that Maximizing Value, Delivering the Project, and Minimizing Waste should be universal goals for project-oriented firms in production system design. Less attention has been paid (Filho et al. 2011) to the supporting infrastructure inside firms represented by decisions on organization, product development, human resources, performance measurement, production planning and control, and quality (Rudberg and Olhager 2003) as compared to structural decision categories as process technology, capacity, facilities, and vertical integration. In other words; the infrastructure provided by the firm has been given less attention in Lean Construction implementation than the structure in construction projects. Sustainable competitive advantage in a firm is created by exploiting properties that cannot easily be copied (Barney 1991) – methods and structures are relatively easy to copy, while the infrastructural part of an operations strategy is not. Harris (1997) reports interactions between the strategic, tactical, and operational levels in Fig. 1, but these are not yet understood in construction. Following Filho (2013) and Acur et al. (2003), understanding Lean Construction as an operations strategy aligning business and operational levels through infrastructural and structural decisions will theoretically lead to a competitive advantage for construction firms.

The decision categories are the type of internal decisions that needs to be made in operations to follow the business and operations strategies – in the case of Lean Construction as an operations strategy; the decision categories reflect how Lean is operationalized. Looking outside the world of Lean, the content of the decisions determines production system design and project delivery systems (Alarcon et al. 2013). Decision categories need to be separated from the competitive criteria/objectives that the firm uses to compete on the external market. Examples of competitive criteria are: cost, quality, delivery performance, flexibility, and innovation (e.g. (Santos et al. 2003)). In construction, cost and delivery are the strongest competitive criteria so far, while innovation (e.g. presenting new models and/or technology) is often met with reluctance from customers. Flexibility or customization is growing stronger as a competitive criterion depending on the market niche (Kemmer et al. 2010).

METHODOLOGY

Following the theoretical structure in Fig. 1, managers on the tactical level are the primary sources of information about their firms' operations strategies. As the operations strategy is frequently implicit (and may deviate in practice from specified formulations

even if it is explicit), in-depth interviews focused on how operations are managed were conducted, seeking knowledge of real life events. The interview data were coded into categories emerging as themes and these categories are used to summarize and present the data in a format that enables comparison with theory. The research does not attempt to formulate an operations strategy for the construction industry, rather the intention is to elucidate possible constituents and priorities of operations strategies in construction. The data set includes managers that work either within or without a Lean implementation in their respective companies.

DATA COLLECTION

The empirical data was collected through interviews with one tactical level manager at each of nine different construction contractors in Sweden, Table 1. Firms with or without an active Lean implementation were sought to increase the external validity of the results. The unit of analysis are operations they handle, taken to represent the general practice at their respective firms from their perspectives. The selection of respondents was based on their position in the contractor firm and their long-term experience of enacting their respective firms’ operations strategy.

Table 1. Respondents.

Respondent	Position at firm
A	Middle manager, reporting directly to top management, liable for a turnover of 100 M€
B	Top manager, responsible for one third of the total business, liable for a turnover of 35 M€
C	Middle manager, reporting directly to top management, liable for a turnover of 50 M€
D	Lean manager, reporting directly to top management, liable for process improvements of 10 M€
E	CEO and cofounder, liable for a turnover of 3.5 M€
F	Platform manager, part of top management, joint liable for a turnover of 1,300 M€
G	Middle manager, reporting directly to top management, liable for a turnover of X M€
H	Middle manager, reporting directly to top management, liable for a turnover of X M€
I	Middle manager, reporting directly to top management, liable for a turnover of X M€

The interviews were semi-structured and about one hour long. The respondents were interviewed during 2013-2015 focusing on discussions reported in Table 2. All interviews were recorded, fully transcribed and the texts were used as the basis for the analysis. The respondents received transcripts of the interviews for approval.

Both authors are active professionals in both academia and the construction industry. This was advantageous for understanding the language and expressions used for naming and attributing objects when interpreting the interviews. A disadvantage with being socialized in construction is the risk of missing obvious points and discrepancies and/or regarding an issue as being settled before it is actually fully understood. Another risk lies in interpreting statements as they appear in our own, rather than the respondents', frames of reference. These risks have been partly mitigated by the two authors always working in parallel with analysis to avoid interpretations being colored by a single person's views.

Table 2. Discussion questions for the interviews.

What is your view on standardisation?	How is your company organised?	How do you handle variation between projects?	How do you balance resources between projects?
What are your relations with subcontractors?	What is your main competitive advantage?	How do you work with experience feedback?	How do you relate to strategies pushed top-down?

ANALYSIS METHOD

The transcripts were read by both authors and the statements were sorted into themes. These themes were identified by finding statements that addressed the same topic e.g. planning. Both authors made the thematic analysis separately to increase the internal validity of the findings and then the themes were compared to reach a consensus view on labelling and sorting. Care was then taken to analyse the statements within the themes to discern how the respondents approached the topic. For example on the topic of standardisation, one respondent described this as being a core value in the organisation while the next respondent addressed it as something made by a central organisation. These shifting angles made it possible to detect the emergent operations strategies. The interview data were condensed and illustrative comments and emerging decision categories are presented in Table 3. Furthermore, the strength of the themes is illustrated in Figure 2 by using colours (Fig. 2 is not meant to be readable). Each block corresponds to a statement made in the interviews so many blocks of the same colour indicate that this was an important topic.

INTERVIEW RESULTS AND ANALYSIS

EMERGING DECISION CATEGORIES

Table 3 shows that the emergent decision categories have different meanings for companies with a Lean implementation and those without. Prominently, a Lean implementation gives the employees in the firm a language when talking about their operations strategy. It was very clear during the interviews that construction firms working in a traditional way reflect less on what they are actually doing and do not see their operations strategy as a deliberate choice.

Continuous improvement emerged as a decision category with all interviewed firms. However, continuous improvement was in the mindset of firms with a Lean focus, while

the other firms did it *ad hoc* at sparse intervals and often by a separate function. The largest contrast arose when the firm representatives spoke about *standardization*. While Lean firms saw standardization as a means to improve flow, the firms focusing resources regarded standardization as difficult and of no value since every project is unique. Furthermore, standards were something set by a central function in the firm and was not always followed in every project for reasons of not suiting the project or not to the managers liking. Decisions on the *supply chain* were in firms focusing flow biased towards collaboration and transparency, while firms focusing resources procured a new supply chain for every project to get the lowest price through subcontractor competition.

Table 3: Emerging decision categories

Decision category	Firms focused on flow (Lean)	Firms focused on resources
Continuous improvement and learning	Is a mindset Systematic approach	Ad hoc "Someone else's responsibility"
Standardization	Standards are a means for improvement of flow Standards include the way to work (how to add value)	Each project has a status of being unique – no need for standardization
Supply chain	Customer value perspective Collaboration and transparency	Unique project focus Procurement in each project
Process versus project	Flow and HOW to deliver value Visualization to see Wholeness	Unique projects – focus on WHAT to deliver
Human resources <i>Values and corporate culture</i>	Commitment – responsibility of and for all employees People are assets Culture carries the way to work – respect and trust	Individuals are carrier of knowledge and skills
Performance measurement	Improvements of processes and ways of working Related to quality and quality defects	Focus on economic bottom line profit Reactive measures (cost, volume, time) Variation due to which individual is involved
Organization <i>Leadership</i>	Not in focus Train the mindset, walk the talk	Resources and organization in projects gives the end results Lack of consistency and self-responsibility in leadership
Planning of project/production	Resource planning – to level out variation in projects	Control in a sequential manner Planning of resources with focus on time and capacity
Long-term perspective	Increased production to survive Long-term changes and investments	Project focus – not always related to long-term vision

Many thoughts were offered from respondents on decisions regarding process versus project focus. This is a crucial point for firms working with Lean, while other firms seem oblivious of the fact that one can view a series of projects as a process. Another interesting difference was the view on human resources; firms working as traditional contractors view their personnel as capacity that are individual carriers of competence and skill. Firms working with lean view their employees as assets. Much effort is put on planning human resource utilization. Performance measurement is in firms focusing resources made by determining costs and counting other reactive measures. Firms with a Lean implementation complement those measurements with process measures as defects and cycle time. When it comes to organization in projects, this was not a strong decision category at firms focusing flow, while it was central at firms focusing resources. The choice of site manager was even identified as the most important factor for success or failure of the project. Decisions on planning at traditional contractors was an activity that supports human resource utilization and organization, while firms focusing flow make decisions to balance resources between projects. The long-term perspective was strongest with firms focusing flow – the traditional contractors made decisions pertaining to the projects, not to support the firm itself.

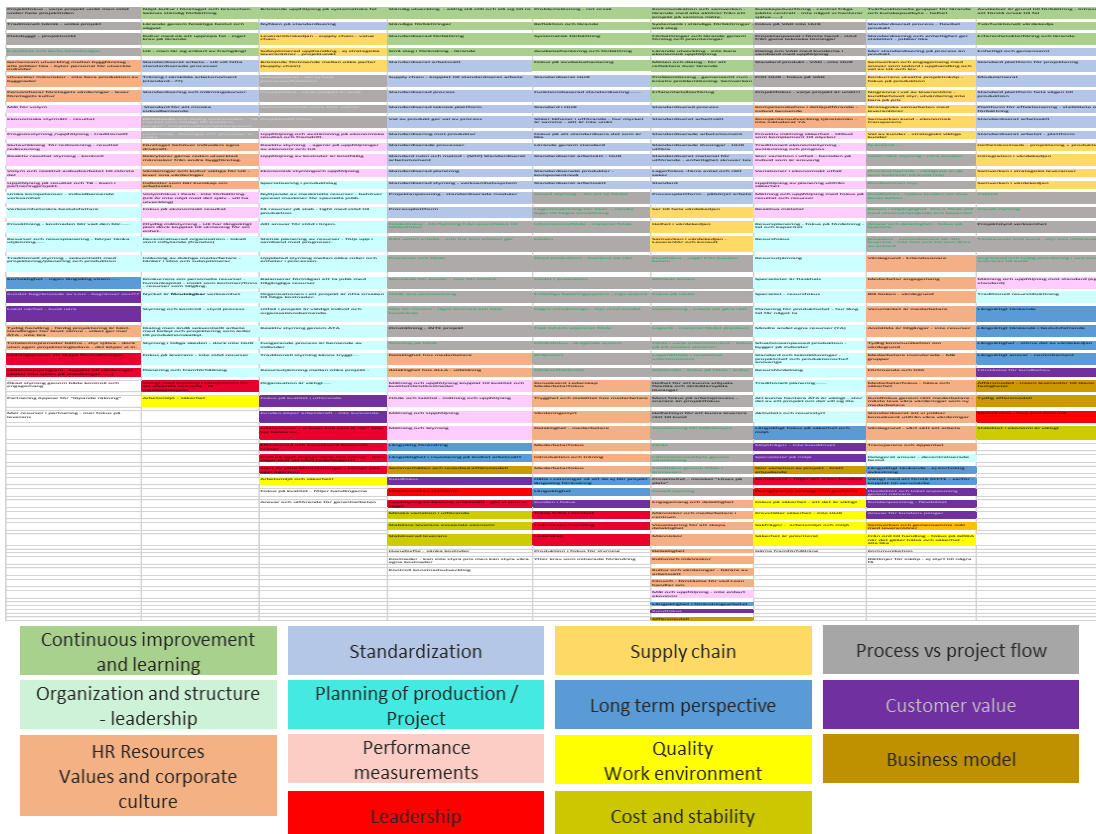


Figure 2: Schematic view of the importance of emergent decision categories.

Many of the tactical managers in traditionally managed construction firms did not have a long-term vision by themselves. Either the long-term strategy was given to them top-

down or they had great trouble figuring out how to use their production knowledge as an asset. In the original data set, three firms had an outspoken Lean operations strategy. By comparing themes and how the tactical managers answered, it was found that five firms actually were working according to Lean principles.

From figure 2 it is readable that companies working in a more traditional way (columns 1, 2, 3, and 7) talk about what they deliver, rather than how this is delivered. Still it is obvious that there is a ‘how’ also at these firms – this is to focus on *what* to deliver, by *what* resources and with *what* organization. Organization in terms of resource planning, human resource management, and finding the right individual were the main decisions. The five other firms (columns 4, 5, 6, 8, and 9) concerned themselves with standardization and process vs project flow. Standardization came across as standardization of work tasks, of technical solutions, but also in processes and relationships e.g. in the supply chain. Process vs project flow was a natural topic as these firms are construction firms, delivering in projects but with the support of an underlying standardized process. Underlying values, culture and employee commitment were more important for the firms focusing flow, Figure 2.

When it comes to competitive criteria, cost reduction as a result of the investment in a Lean operations strategy is identified by firms focusing on flow. As a contrast one of the tactical managers at a resource focused firm stated that “the cost is what it is”. Customer value is actively brought up as a competitive criterion by all the firms working with a flow-oriented operations strategy, while the traditional construction firms relate to customer value as “working with the wallet of the customer”.

THEORETICAL RECONNECTION

Table 4 compares decision categories from earlier publications with those in Table 3.

Table 4: Decision categories condensed by Rudberg and Olhager (2003) compared to those found in this research

	Structural categories	Infrastructural categories
Decision categories from the manufacturing industry	Process technology	Human resources
	Capacity	Organization
	Facilities	Quality
	Vertical integration	Production planning and control
		Product development
		Performance measurement
Decision categories proposed for Lean Construction in this research	Standardization	Human Resources
	Capacity/organization in projects	Continuous improvement
	Work Environment	Long-term Perspective
	Vertical Integration	Production planning
		Process vs Project
		Performance measurement

The differences between the decision categories published for the manufacturing industry and the proposed ones are bold in Table 4. Standardization is a more narrow way of presenting the decision on process technology; to use a standardized solution (and its dedicated production process) or not. Work environment (as opposed to Facilities) is an important decision for many construction companies with the increasing safety awareness in the business. Continuous improvement is seen as a challenge in construction and arises as a more important decision than quality – several of the respondents connect quality with customer focus placing it as a competitive criterion rather than a decision category. Long-term perspective is coupled to continuous improvement and is an active decision by construction firms focusing flow. In the manufacturing industry, product development is an important decision that supports the long-time survival of the firm, but this does emerge as a priority with construction firms who integrate product development in the construction design phase. The decision that most tactical managers struggle with is whether to prioritize the process or the projects. Making that priority is where Lean as an operations strategy emerges most strongly; focusing the process will reveal instantaneously if a manager acts according to Lean principles or not. Infrastructural decision categories is where manufacturing and construction firms differ the most; identifying them as firms with different logics and different ways of creating competitive advantage.

CONCLUSIONS

The decision categories in an operations strategy in Lean construction are proposed as: Standardization, Capacity/organization in Projects, Work Environment, Supply Chain, Work Environment, Human Resources, Continuous Improvements, Production Planning, Long-term Perspective, Process vs project, and Performance Measurement. The most important difference from earlier publications of decision categories stemming from the manufacturing industry is that there is a larger focus on the strain between project and process focus. The method used in this research shows that it is possible to detect the emergent operations strategy of a construction firm and trace the enactment of Lean Construction.

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